TECHNICAL SUPPORT DOCUMENT (TSD)

Maricopa County Air Quality Department

PERMIT NUMBER:	V03002	**App. ID(s):**	408416
BUSINESS NAME:	City of Phoenix Public Works Dept. SR-85 Municipal Solid Waste Landfill	**Revision(s):**	2.0.0.0
SOURCE TYPE:	NON-HAZARDOUS MSWLF	**Revision Type(s):**	Renewal
PERMIT ENGINEER:	Eric Funderburk	**Date Prepared:**	

OVERVIEW:

The STATE ROUTE 85 MUNICIPAL SOLID WASTE LANDFILL (SR85) is an active class I waste municipal solid waste landfill (MSWLF) located at 28631 W PATTERSON RD, BUCKEYE, AZ 85326. SR85 is owned and operated by the City of Phoenix Public Works Department (COP). SR85 accepts approximately one million tons of waste annually consisting of household, light commercial and business grade trash from the City and private municipal waste collections. SR85 has been designed with a total capacity of 298 million tons and therefore triggers Part 70 permitting requirements in accordance with NSPS WWW.

SR85 operates under Title V Permit Number V03002 issued by MCAQD in October, 2003. SR85 is subject to New Source Performance Standards (NSPS), 40 CFR 60, Subpart WWW Standards of Performance for Municipal Solid Waste Landfills, and 40 CFR 63, Subpart AAAA National Emission Standards for Hazardous Air Pollutants (NESHAP) for Municipal Solid Waste Landfills. SR85 is categorized as a major source under 40 CFR §60.752(b), as it meets the minimum specifications (design capacity ≥ 2.5 MM cubic meters). The initial stage site development was commenced in 2005 with the construction of the entrance and support facilities and the excavation and lining of the first cell. The first load of waste was accepted on January 2, 2006. The Title V Air Quality Operating Permit was originally issued April 4, 2005.

SR85 is operated using an area fill method. Solid waste is received via waste haul trucks and deposited in the landfill and spread into thin layers and compacted to the smallest practical volume within specified areas known as cells. Each day, stockpiled dirt cover material or alternative daily cover is added to cover the waste. The filling process for the first cell will occur in four phases. As each phase reaches capacity, a final cover comprised of a five-foot thick monolithic soil layer with a very limited permeability will be constructed. As part of the final cover construction operation, extensive hydro-seeding will be performed to stabilize the soils and minimize erosion and offsite discharge of soils during adverse weather events. The first phase, Cell 1 Phase 1, has been completely filled and a final cover has been installed. The movement of landfill equipment to place the waste and cover it with stockpile soil generates substantial fugitive particulate emissions.

Compacted waste is decomposed over time by various natural processes which produce gaseous methane, carbon dioxide, and numerous non-methane organic compounds (NMOCs) including volatile organic compounds (VOCs) and hazardous air pollutants (HAPs).

The SR85 Landfill currently has one active cell (Cell-1). Cell-1 has achieved Stage 4 of "methanogenesis" (see discussion below). Only municipal solid waste comprised of residential and commercial wastes, and sewage sludge as well as construction debris from the City service area are disposed at the SR85 Landfill. The SR85 Landfill does not accept for disposal any hazardous wastes or asbestos-containing materials.

TITLE V STATUS / ATTAINMENT: Maricopa County is currently designated marginal non-attainment for ozone and as non-attainment for PM10. SR85 is subject to Title V permitting under the requirements of 40 CFR Part 60 Subpart WWW, §60.752(b).

LANDFILL GAS CAPTURE AND CONTROL SYSTEM (GCCS): To limit the emission of the gaseous compounds through the landfill surface and into the atmosphere, a gas collection and control system (GCCS) was designed and approved for construction in the fall of 2006 in accordance with NSPS WWW. The collection network includes horizontal collectors (perforated piping) installed in the refuse prism during the filling operations as well as vertical wells installed after the final cover is in place. This collection system is connected to vacuum pumps to aid in the collection and transport of gases. The gases are discharged from the pumps into the control system consisting of enclosed flares where it is burned to reduce the discharge of methane, NMOCs, VOC and HAPs. The products of combustion of the landfill gases are NOx, SOx, CO, CO_2, PM, dioxins/furans, HCl and water vapor. The flare system currently includes three enclosed flares at a single flare station with a total heat rating of 100 MMBTU/hr;

- FL-1: Flare 1 – 18 MMBTU/hr
  Height: 30.75 ft
  Diameter: 6.00 ft
- FL-2: Flare 2 – 42 MMBTU/hr
  Height: 32.75 ft
  Diameter: 9.50 ft
- FL-3: Flare 3 – 40 MMBTU/hr
  Height: 32.50 ft
  Diameter: 8.83 ft

Each flare is equipped with a condensate leachate injection system and is capable of 98% or higher destruction efficiency for NMOC and VOC. The three current flares were most recently performance tested in April of 2012. Source emission testing is performed at regular intervals to verify the destruction efficiency of the flares as per NSPS WWW. The flares meet the 98% destruction efficienty and/or 20 ppmvd outlet NMOC concentration standard provided but the NSPS.

Installation and operation of the GCCS began in 2006 and continues to expand as the landfill operates in phases and will continue to expand until the completion of a facility-wide system. At this time there are 74 horizontal collectors and 5 vertical wells.

LEACHATE COLLECTION: SR85 has a leachate collection system installed over the base liner system to remove leachate and stormwater that percolates through the waste mass. As water from rainfall and the use of water for dust control measures trickles down through the refuse mass collecting contaminants, liquid waste is produced as leachate which collects at the bottom of the landfill. The leachate collection system includes drainage and a sump beneath landfill from where collected leachate is pumped up to groud level. The leachate is used as a dust suppressant and collected in an evaporation pond. In either case the evaporation process emits fugitive organic pollutants into the atmosphere. Design and operation of the leachate collection system has been performed in accordance with 40 Code of Federal Regulations (CFR) Part 258 requirements.

Condensate and leachate is collected in sumps located at engineered low points in the header system and then conveyed to a central storage tank at the flare station. To prevent buildup of desorbed gases in the tank, an exhaust vent system was designed such that any air leaving the tank is passed through granulated activated charcoal canister to remove any organic gases and odors desorbed into the air above the condensate/leachate. This tank is monitored on a regular basis using a PID and/or FID organic gas- analyzing instrument to determine if gas breakthrough has occurred.

NON-ROAD ENGINES: There are four trailer tippers of 106 bhp each operating at the facility which qualify as non-road engines as defined by 40 CFR 1068.30, and are not subject to regulation. Additionally, potential emissions therefrom are not considered or included in the overall emissions profile for this landfill. Additionally the landfill has diesel fuel internal combustion engines-driven equipment, including an 80 hp emergency water pump, a 49 hp emergency generator, light plants with generators less than 25 hp, a leachate pump with engine driver, and a 20 hp portable generator for the operation of small landfill maintenance equipment. These units are considered insignificant activities not contributing to the overall emissions from the landfill.

HAULING OPERATIONS AND MAINTENANCE: Also located onsite is a waste hauling operation which consists of waste collection vehicle operations and maintenance. Collection vehicles operate from this site and provide waste collection services for the local area. Fueling and maintenance of these vehicles is performed on an as needed basis.

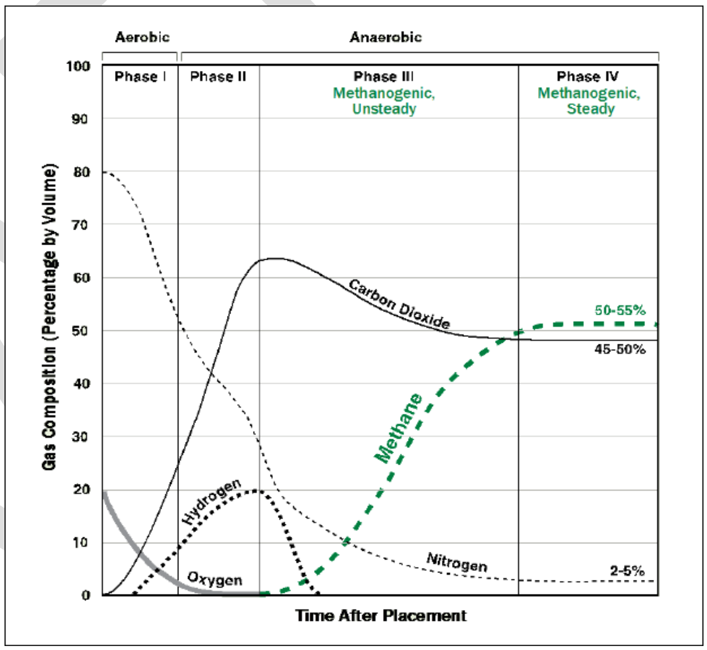
ASBESTOS / PCS / LWS HAZARDOUS WASTE: SR85 does not receive friable and non-friable asbestos containing waste, petroleum contaminated soil (PCS), liquid waste for solidification (LWS), or any hazardous wastes as defined by 40 CFR Part 261 (RCRA).

EMISSIONS:

EMISSIONS OVERVIEW: LFG is produced through bacterial decomposition, volatilization and chemical reactions. Most LFG is produced by bacterial decomposition that occurs when organic waste solids, food (i.e. meats, vegetables), garden waste (i.e. leaf and yardwaste), wood and paper products, are broken down by bacteria naturally present in the waste and in soils. Volatilization generates LFG when certain wastes change from a liquid or solid into a vapor. Chemical reactions occur when different waste materials are mixed together during disposal operations. Additionally, moisture plays a large roll in the speed of decomposition. Generally, the more moisture, the more LFG is generated, both during the aerobic and anaerobic conditions.

Bacteria decompose landfill waste in four phases. The composition of the gas produced changes with each of the four phases of decomposition. Landfills often accept waste over a 20 to 30-year period, so waste in a landfill may be undergoing several phases of decomposition at once. This means that waste in one area might be in a different phase of decomposition than more recently buried waste in another area.

- Phase 1 – Initial Adjustment – Short-term phase characterized by both aerobic and anaerobic digestion. CH_4 not yet generated.
- Phase 2 – Transition Phase – Short-term phase to transition to anaerobic conditions. CO_2 approaches maximum emission rate. CH_4 not yet generated.
- Phase 3 – Acid Phase – Relatively short-term phase where organic acids and hydrogen gas are produced. This phase is typified by: production of organic volatile fatty acids (i.e. acetic acid); generation of hydrogen (up to 20% by volume in the LFG) and CO_2; pH drop of the leachate due to the existence of the acids and CO_2; high biochemical and chemical oxygen demand. CH_4 not yet generated.
- Phase 4 – Methane Fermentation Phase – Long-term anaerobic phase of CH_4 generation.



Ideally, the composition of LFG eventually achieves 45-60% methane and 40-60% carbon dioxide with trace amounts (<1 percent) of nitrogen, oxygen, hydrogen sulfide, hydrogen, and nonmethane organic compounds (NMOCs). The more organic waste and moisture present in a landfill, the more LFG is produced by the bacteria during decomposition. The more chemicals disposed in a landfill, the more likely volatile organic compounds and other gasses will be produced.

Methane (CH_4) naturally generated by decaying organic wastes in a landfill is a process known as methanogenesis. Methanogenesis is the formation of methane by microbes known as methanogens. Organisms capable of producing methane have been identified as distinct from both eukaryotes and bacteria, although many live in close association with anaerobic bacteria. Methanogens do not use oxygen to respire (anaerobic); in fact, oxygen inhibits the growth of methanogens. Depending on pH and temperature, methanogenesis has been shown to use carbon from other small organic compounds, such as formic acid (formate), methanol, methylamines, dimethyl sulfide, and methanethiol. The formation of methane in MSWLF is the desired chemistry as this chemistry represents the best and most effiecient breakdown of landfill materials. Methane is a greenhouse gas up to 35 times as potent as carbon dioxide and is a driver of climate change. Landfills are the United States' third largest source of methane emissions, according to the EPA. In properly managed landfills, this gas is collected and can be utilized as a combustive fuel. Regulations require emissions of methane to be captured and combusted either by flare or LFG engine.

SR85 has received no higher operating values (HOV) for well temperature or other authorized deviations allowed under NSPS WWW. SR85 appears to be producing LFG fairly close to that predicted by the LandGEM model (see below). Emperical data from the 2012 performance test indicates in 2012 there was a collected 2,662 cfm of LFG routed to the flare station. LandGEM indicates 1.243E+09 ft³/year of LFG for 2012, which when divided by (8760 hr/yr*60 min/hr) yields 2,365 cfm. AP-42 adivises the assumption that a GCCS may collect anywhere between 65 and 85% of total LFG generated. The GCCS at SR85 appears to be achieving a very high efficiency, when compared to the model. MSWLF in the Southwest are typically "late blooming" in that achievement of the phased methanogenesis discussed above occurs later than predicted. This has been documented for other MSWLF in Maricopa County. HOVs for well temperature and other operating parameters are typically used to compensate for the differences in environmental factors.

LANDGEM MODEL POTENTIAL EMISSIONS: The LFG Emissions Model (LandGEM) is an EPA tool which estimates emission rates for total LFG, methane, carbon dioxide, nonmethane organic compounds, and individual air pollutants from MSWLF. LandGEM can use either site-specific data to estimate emissions or default parameters if no site-specific data is available. The model contains two sets of default parameters, Clean Air Act (CAA) defaults and inventory defaults. The CAA defaults are based on federal regulations for MSW landfills laid out by the CAA and can be used for determining whether a landfill is subject to the control requirements of these regulations. The inventory defaults are based on emission factors in EPA's Compilation of Air Pollutant Emission Factors (AP-42) and can be used to generate emission estimates for use in emission inventories and air permits in the absence of site-specific test data. The following data is used to create the model for SR85;

LandGEM MODEL PARAMETERS		
Methane Generation Rate, k	0.020	$year^{-1}$
Potential Methane Generation Capacity, L_o	170	m^3/Mg
NMOC Concentration	2,311	ppmv as hexane*
Methane Content	50%	by volume

* *Based on April 2012 performance test.*

Total VOC content is considered to be 39% of NMOC concentrations for a non- co-disposal landfill. The capture efficiency of the GCCS is considered to to be 75%, as per EPA guidance contained in AP-42 Chapter 2.4. Destruction efficiency of flares is required to achieve 98% under NSPS WWW. The detruction efficiency is applied to all HAP consitunents of AP-42 (except mercury), as well as the to the NMOC/VOC element of LFG, as per the cited guidance. Using the LandGEM model, post flaring emissions can be estimated by assuming 98% of the 75% of all NMOC and VOC generated in the landfill collected by the GCCS are oxidized by the flare. 25% are considered fugitive as these LFG emissions defy capture methods.

HYDROCHLORIC ACID (HCl): In the combustion of a waste chlorinated hydrocarbon, hydrochloric acid will be present in the exhaust gases as well as some free chlorine. An example of such a problem is as follows, assume that trichloroethylene ($CHCl{=}CCl_2$) is to be incinerated. If it is burned with air, the following stoichiometry is observed;

$$CHCl{=}CCl_2 + 2O_2 \rightarrow 2CO_2 + HCl + Cl_2$$

Performing a similar conversion for the chlorinated constituents of LFG as provided using AP-42, maximum potential HCl emissions are calculated at 9.98 tpy, which is essentially the major single HAP threshold. The source is required to peform a performance test to determine the outlet concentration of HCl for a flare in order to develop a more empirical estimate of site-wide HCl emissions.

HAP MODELING: AERSCREEN is an EPA dispersion model that produces "worst-case" estimates of 1-hour concentrations for a single source, without continuous meteorological data. AERSCREEN also includes conversion factors to estimate "worst-case" 3-hour, 8-hour, 24-hour, and annual concentrations.

A screen model was performed on HCl. SR85 has the potential to convert approximately 20 tons per year of various chlorinated organics captured by the GCCS to 9.98 tons per year of HCl by the flare oxidation process discussed above. The AERSCREEN model was run for HCl and the results were converted for each potential HAP proportionate to their respecitive potential mass emission rates according to LandGEM. The AERSCREEN model predicts exceedances Chronic Ambient Air Concentrations for two HAP.

The screen model was performed two ways. The first scenario considered that the amount of LFG generated as predicted by LandGEM and captured by the GCCS (75%) was distribute proportionately among the three flares based on the flare's rated capacities. The second scenario considered all the collected LFG to be passed through one flare and each flare was modeled. The results yielded the similar results. The following HAPs as modeled are believed to exceed the CAAC within the permit term; Acrylonitrile, and Trichloroethylene (trichloroethene).

The above discussed added performance test is now required in the permit to help better understand the actual emissions of these potential health risks. As a preliminary analysis, the performance test for HCl has a dual purpose. Firstly, the test will be used to determine the actual total mass emission rate of HCl itself. The need for this is triggered by the 9.98 tpy potential figure yielded by LandGEM and AP-42 guidance. Secondly, the use of HCl as a surrogate can be used to determine the outlet concentrations of other HAP. The outlet concentrations and emission rates of other HAP may be considered to be proportional to the outlet concentration and emission rate of HCl.

SITE-WIDE EMISSIONS SUMMARY: The following emissions summary includes all potential process and fugitive emissions from SR85 for the 2021 inventory year:

Gas / Pollutant	***Source Emissions (tpy)***	***Source Emissions (lbs/yr)***	***Fugitive Emissions (tpy)***
Total landfill gas (LFG):	1,394	2,787,900	23,233
Volatile organic compounds (VOC):	3.61	7,212	72
Carbon monoxide (CO):	20.78	41,569	3.04
Oxides of nitrogen (NOx):	17.47	34,935	-
Sulfur dioxide (SO2):	7.32	14,648	-
Particulate (PM10/PM2.5):	6.72	13,436	134
Total hazardous air pollutants (HAPs):	10.45	20,900	19.94
Hydrochloric Acid:	9.98	19,970	-
Acrylonitrile*:	0.02	31	-
Trichloroethylene (trichloroethene)*:	0.02	34	-

** Screen modeling predicts the exceedance of the Chronic Ambient Air Concentration health standard for these LFG constituents.*

The only point source emissions entered into the emissions profile at SR85 are the three flares. Other sources of emissions include non-road engines and fugitive emissions of LFG, fugitive emissions from leachate collection and fugitive dust particulate emissions generated from landfill equipment, storage pile/cover operations, and travel on paved and unpaved roads, all of which are not considered for this source.

This site-wide emissions analysis was performed as standard practice for all renewal actions. These calculations roughly corroborate prior estimates.

ALLOWABLE EMISSIONS: The following adjustments were made to the permitted Allowable Emissions.

Former Permitted Allowable 12-mo Rolling Total Emissions	***(tpy)***
Non-Methane Organic Compounds (NMOCs)	245.00
Volatile Organic Compounds (VOCs)	76.00
Nitrogen Oxides (NOx)	25.00

Revised Permitted Allowable 12-mo Rolling Total Emissions	***(tpy)***
Volatile Organic Compounds (VOCs)	76.00
Nitrogen Oxides (NOx)	25.00
Hydrochloric Acid (HCl)	9.98

It was determined appropriate to remove the NMOC limit from the permit as NMOC is not a regulated criteria pollutant. It is understood that any testing which demonstrates concentrations of NMOC (non-methantic organic compounds) or TGNMO (total gaseous nonmethane organics) will be subjected to the above described method for estimating the VOC content, the target criteria pollutant. There is no reason at this time to implement any higher level of stringency as the estimated VOC emissions as presented are largely mitigated by flaring as required by the federal NSPS and conditions relating to the testing and maintenance of these controls are federally enforceable. These provisions are contained in the permit and the source has been compliant with them.

A limit for hydrochloric acid (HCl) is added to the Allowable Emissions as the emissions analysis using the prescribed guidance discussed in this document indicates a potential for annual emissions of HCl to exceed 10.0 tpy. The estimate for the current (pending) permit term for this renewal is just under 10.0 tpy, but it is likely that the same analysis will yield a greater figure when performed again in 5 years. The emission limit for HCl is included in the permit and a requirement to include a performance test for HCl during the permit term is also included in the permit. The performance test for HCl has a dual purpose. It serves to create a site-specific emission factor for HCl, which will likely be less than the modelled value. It also serves to act as a surrogate for the other HAPs which are identified as exceeding an ambient air standard as modelled. This is possible because the proportionality of the various constituents as presented in the AP-42 section will be used to estimate the other pollutants of concern, with the imperical data provided by a test for HCl outlet concentration.

APPLICABILITY OF FEDERAL REGULATIONS:

- *NSPS WWW: Standards of Performance for Municipal Solid Waste Landfills:* Under 40 CFR 60.750, MSWLF contructed after May 30, 1991 are subject to this subpart. SR85 is categorized as a major source under 40 CFR 60.752(b), as it meets the minimum specifications (design capacity ≥ 2.5 MM cubic meters).
- *NESHAP AAAA: National Emission Standards for Hazardous Air Pollutants: Municipal Solid Waste Landfills:* Under 40 CFR 63.1935 of this subpart, a MSWLF is subject to the NESHAP if the landfill has a design capacity of greater than 2.5 MM Mg and 2.5 MM m^3 and has estimated NMOC emissions over 50 Mg per year.
- *NESHAP M: National Emission Standard for Asbestos:* This 40 CFR Part 61 subpart contains operating standards for active waste dispoasal sites accepting asbestos under §61.154. SR85 Does not receive asbestos and this therefore not subject to this subpart.
- *NSPS Cc: Emission Guidelines and Compliance Times for Municipal Solid Waste Landfills:* This 40 CFR Part 60 subpart contains emission guidelines and compliance times for the control of certain designated pollutants from certain designated municipal solid waste landfills in accordance with section 111(d) of the Act and subpart B. The designated facilities to which these guidelines apply is each existing MSW landfill for which construction, reconstruction or modification was commenced before May 30, 1991. Not Applicable.
- *40 CFR Parts 260—282: Resource Conservation and Recovery Act (RCRA):* SR85 is not subject to the Resource Conservation and Recovery Act (RCRA), 40 CFR Parts 260 through 282 (Parts 239-258 are general, non-RCRA regulations for solid waste disposal at MSW. Leachate collection, for example as discussed above is regulated in this subchapter). An examination of the criteria provided in 40 CFR Part 261, Identification and Listing of Hazardous Waste, indicates none of the materials accepted at SR85 qualify as hazardous waste. A "co-diposal" landfill takes material waste classified as hazardous and would be subject to additional federal regulations under RCRA. SR85 is not a co-disposal MSWLF, and does not trigger RCRA.
- *Greenhouse Gas (GHG) Regulation:* As of the June 23, 2014 SCOTUS ruling in the case, *"Utility Air Regulatory Group v. EPA"* the EPA does not regulate GHGs unless the source is major for one or more criteria pollutants and/or HAPs; and, the potential emissions from a new source or construction are anthropogenic (man-made) carbon dioxide equivalents, CO_2(e) over the significance level of 100,000 tpy for new sources or 75,000 tpy for a modification. Biogenic emissions of GHG are considered to be part of the natural carbon cycle, and are not currently regulated. Anthropogenic GHG emissions at SW are estimated to be far below the significance level, and are therefore not included in the emissions profile for this source.

SUMMARY OF FEDERALLY AND LOCALLY ENFORCABLE MCAQD SIP RULES:

SIP Rule 26 - Air Quality Models	(Revised: 04/12/1982)
SIP Rule 27 - Performance Tests	(Revised: 04/12/1982)
SIP Rule 28 - Permit Fees	(Revised: 06/18/1982)
SIP Rule 30 - Visible Emissions	(Revised: 04/12/1982)
SIP Rule 32 - Odors and Gaseous Emissions	(Revised: 07/27/1972)
SIP Rule 40 - Record Keeping and Reporting	(Revised: 04/12/1982)
SIP Rule 41 - Monitoring	(Revised: 04/12/1982)
SIP Rule 42 - Testing and Sampling	(Revised: 07/27/1972)
SIP Rule 43 - Right of Inspection	(Revised: 07/27/1972)
SIP Rule 100 - 500 Monitoring and Records	(Revised: 11/05/2012)
SIP Rule 140 - Excess Emissions	(Revised: 09/05/2001)
SIP Rule 220 - Permits to Operate	(Revised: 07/13/1988)
SIP Rule 300 - Visible Emissions	(Revised: 07/28/2010)
SIP Rule 310 - Fugitive Dust From Dust-Generating Operations	(Revised: 12/15/2010)
SIP Rule 600 - Emergency Episode	(Revised: 07/13/1988)

SUMMARY OF APPLICABILE MCAQD RULES:

County Rule 100 - General Provisions and Definitions	(Revised: 02/03/2016)
County Rule 200 - Permit Requirements	(Revised: 02/03/2016)
County Rule 210 - Title V Permit Provisions	(Revised: 02/03/2016)
County Rule 270 - Performance Tests	(Revised: 11/15/1993)
County Rule 280 - Fees	(Revised: 05/26/2010)
County Rule 300 - Visible Emissions	(Revised: 03/12/2008)
County Rule 310 - Fugitive Dust from Dust-Generating Operations	(Revised: 01/27/2010)
County Rule 320 - Odors and Gaseous Air Contaminants	(Revised: 07/02/2003)
County Rule 321 - Municipal Solid Waste Landfills	(Revised: 11/18/2015)
County Rule 360 - New Source Performance Standards	(Revised: 11/18/2015)
County Rule 370 - Federal Hazardous Air Pollutant Program	(Revised: 11/18/2015)

LandGEM Results and Emissions Estimates

Enter year of emissions inventory:	2021
Minimum destruction efficiency for organics:	98%
Approximate total capture efficiency of GCCS:	75%
VOC fraction of NMOC (39% no co-disposal, 85% co-disposal):	39%
Volume conversion (ft³/m³):	35.31

LandGEM Gas / Pollutant	***LandGEM (m³/yr)***	***(tpy)***	***(acfm)***	***Post flare (tpy)***	***Fugitive***
Total landfill gas	67,650,000	92,930	4,545		
Methane	33,820,000	24,820			
Carbon dioxide	33,820,000	68,110			
NMOC	156,300	616			
VOC		240		3.61	60.10
Carbon monoxide		12.14			
Hydrogen sulfide		3.80			

Enclosed Flare Products of LFG Combustion (AP-42)	***EF (lb/MM dscf CH4)***	***Post flare (tpy)***
Draft AP-42 Table 2.4-4 (10/08)		
Oxides of nitrogen (NOx)	39.00	17.47
Carbon monoxide (CO)	46.00	20.60
Particulate (PM10/PM2.5)	15.00	6.72
Dioxin/Furan (HAP)	4.20E-07	1.88E-07
Current AP-42 Table 2.4-5 (11/98)		
Oxides of nitrogen (NOx)	40.00	17.92
Carbon monoxide (CO)	750.00	335.91
Particulate (PM10/PM2.5)	17.00	7.61

LandGEM HAP / Pollutant	***(tpy)***	***MW (g/mol)***	***Post flare (tpy)***	***Fugitive***	***Formula***	***#Cl***	***#Cl×[Cl] = 35.45 (g/mol)***	***[HCl] = 36.46 (tpy)***	***#S***	***#S×[S] = 32.07 (g/mol)***	***[SO2] = 64.07 (tpy)***
Hydrochloric Acid - HAP - created by combustive controls			9.98								
1,1,1-Trichloroethane (methyl chloroform) - HAP	0.20	133.41	0.00	0.05	C2H3Cl3	3	106.35	0.1194			
1,1,2,2-Tetrachloroethane - HAP/VOC	0.57	167.85	0.01	0.14	C2H2Cl4	4	141.80	0.3650			
1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	0.74	98.97	0.01	0.18	C2H4Cl2	2	70.90	0.3981			
1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.06	96.94	0.00	0.02	C2H2Cl2	2	70.90	0.0332			
1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.13	98.96	0.00	0.03	C2H4Cl2	2	70.90	0.0680			
1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.06	112.99	0.00	0.02	C3H6Cl2	2	70.90	0.0299			
2-Propanol (isopropyl alcohol) - VOC	9.30	60.11	0.14	2.33							
Acetone	1.26	58.08	0.02	0.31							
Acrylonitrile - HAP/VOC	1.04	53.06	0.02	0.26							
Benzene - No or Unknown Co-disposal - HAP/VOC	0.46	78.11	0.01	0.11							
Benzene - Co-disposal - HAP/VOC	-										
Bromodichloromethane - VOC	1.57	163.83	0.02	0.39							
Butane - VOC	0.90	58.12	0.01	0.22							
Carbon disulfide - HAP/VOC	0.14	76.13	0.00	0.03	CS2				2	64.14	0.1691
Carbon monoxide	12.14	28.01	0.18	3.04							
Carbon tetrachloride - HAP/VOC	0.00	153.84	0.00	0.00	CCl4	4	141.80	0.0013			
Carbonyl sulfide - HAP/VOC	0.09	60.07	0.00	0.02	COS				1	32.07	0.0714
Chlorobenzene - HAP/VOC	0.09	112.56	0.00	0.02	C6H5Cl	1	35.45	0.0207			
Chlorodifluoromethane	0.35	86.47	0.01	0.09	CHClF2	1	35.45	0.1078			
Chloroethane (ethyl chloride) - HAP/VOC	0.26	64.52	0.00	0.06	C2H5Cl	1	35.45	0.1078			
Chloroform - HAP/VOC	0.01	119.39	0.00	0.00	CHCl3	3	106.35	0.0075			
Chloromethane - VOC	0.19	50.49	0.00	0.05	CH3Cl	1	35.45	0.0995			
Dichlorobenzene - (HAP for para isomer/VOC)	0.10	147.00	0.00	0.02	C6H4Cl2	2	70.90	0.0348			
Dichlorodifluoromethane	5.99	120.91	0.09	1.50	CCl2F2	2	70.90	2.6543			
Dichlorofluoromethane - VOC	0.83	102.92	0.01	0.21	CHCl2F	2	70.90	0.4313			
Dichloromethane (methylene chloride) - HAP	3.68	84.94	0.06	0.92	CH2Cl2	2	70.90	2.3227			
Dimethyl sulfide (methyl sulfide) - VOC	1.50	62.13	0.02	0.38	C2H6S				1	32.07	1.1369
Ethane	82.83	30.07	1.24	20.71							
Ethanol - VOC	3.85	46.08	0.06	0.96							
Ethyl mercaptan (ethanethiol) - VOC	0.44	62.13	0.01	0.11	C2H6S				1	32.07	0.3352
Ethylbenzene - HAP/VOC	1.51	106.16	0.02	0.38							
Ethylene dibromide - HAP/VOC	0.00	187.88	0.00	0.00							
Fluorotrichloromethane - VOC	0.32	137.38	0.00	0.08	CCl3F	3	106.35	0.1891			
Hexane - HAP/VOC	1.76	86.18	0.03	0.44							
Hydrogen sulfide	3.80	34.08	0.06	0.95	H2S				1	32.07	5.2467
Mercury - HAP - unaffected by combustive controls	0.00	200.59	0.00	0.00							
Methyl ethyl ketone - HAP/VOC	1.59	72.11	0.02	0.40							
Methyl isobutyl ketone - HAP/VOC	0.59	100.16	0.01	0.15							
Methyl mercaptan - VOC	0.37	48.11	0.01	0.09	CH4S				1	32.07	0.3644
Pentane - VOC	0.74	72.15	0.01	0.18							
Perchloroethylene (tetrachloroethylene) - HAP	1.90	165.83	0.03	0.47	C2Cl4	4	141.80	1.2275			
Propane - VOC	1.50	44.09	0.02	0.38							
t-1,2-Dichloroethene - VOC	0.84	96.94	0.01	0.21	C2H2Cl2	2	70.90	0.4645			
Toluene - No or Unknown Co-disposal - HAP/VOC	11.12	92.14	0.17	2.78							
Toluene - Co-disposal - HAP/VOC	-										
Trichloroethylene (trichloroethene) - HAP/VOC	1.14	131.40	0.02	0.28	C2HCl3	3	106.35	0.6969			
Vinyl chloride - HAP/VOC	1.41	62.50	0.02	0.35	C2H3Cl	1	35.45	0.6054			
Xylenes - HAP/VOC	3.94	106.16	0.06	0.99							
							HCl emissions:	**9.98**		*SO2 emissions:*	**7.32**

AERSCREEN

LandGEM:
2.28 lb/hr - HCl
3,409 cfm - LFG capture rate for 2021
- 75% capture & 2% uncombusted assumed for HAPs for AERSCREEN model, exept for HCl and mercury; potential emissions of HCl are the result of the oxidation of all chlorine containing organics (75% capture, 98% combustion). ***No fugitive HAPs are modeled.***

LFG Heat Value:
500 BTU/ft³ - heating value for LFG
1,704,507 BTU/min
7,158,810 cal/s - heat release rate
- Landfill gas has a heating value of ~16,785 – 20,495 kJ/m³ (450 – 550 Btu/ft³)

SCENARIO 1: ALL FLARES IN USE PROPORTIONATE TO RATED CAPACITY

FL-1:	FL-2:	FL-3:	
0.61	0.85	0.81	lb/hr - HCl
30.8	32.8	32.5	ft - stack height
72	114	106	in - diameter
1,045.1	1,475.4	1,338.7	°F - rated temperature
19,559	17,525	12,917	scfm - exhaust
15.2	95.5	74.1	µg/m³ - HCl conc.

HAP	LandGEM (tpy)	Post-flare*	AAAC (mg/m³)	CAAC (mg/m³)	FL-1: 1-hr conc. (mg/m³)	FL-1: Scaled annual mg/m³)	FL-2: 1-hr conc. (mg/m³)	FL-2: Scaled annual mg/m³)	FL-3: 1-hr conc. (mg/m³)	FL-3: Scaled annual mg/m³)	EXCEED?	
Hydrochloric Acid	-	9.98	16	2.09E-02	***1.52E-02***	1.52E-03	***9.55E-02***	9.55E-03	***7.41E-02***	7.41E-03	-	-
1,1,1-Trichloroethane (methyl chloroform)	0.20	0.00	2,075	2.30E+00	4.53E-06	4.53E-07	2.84E-05	2.84E-06	2.21E-05	2.21E-06	-	-
1,1,2,2-Tetrachloroethane	0.57	0.01	18	3.27E-05	1.30E-05	1.30E-06	8.20E-05	8.20E-06	6.36E-05	6.36E-06	-	-
1,1-Dichloroethane (ethylidene dichloride)	0.74	0.01	405	7.29E-05	1.68E-05	1.68E-06	1.05E-04	1.05E-05	8.18E-05	8.18E-06	-	-
1,1-Dichloroethene (vinylidene chloride)	0.06	0.00	38	2.09E-01	1.37E-06	1.37E-07	8.61E-06	8.61E-07	6.68E-06	6.68E-07	-	-
1,2-Dichloroethane (ethylene dichloride)	0.13	0.00	405	7.29E-05	2.87E-06	2.87E-07	1.80E-05	1.80E-06	1.40E-05	1.40E-06	-	-
1,2-Dichloropropane (propylene dichloride)	0.06	0.00	250	4.17E-03	1.44E-06	1.44E-07	9.03E-06	9.03E-07	7.01E-06	7.01E-07	-	-
Acrylonitrile	1.04	0.02	38	2.79E-05	2.36E-05	2.36E-06	1.49E-04	1.49E-05	1.15E-04	1.15E-05	-	CAAC
Benzene - No or Unknown Co-disposal	0.46	0.01	1,276	2.43E-04	1.05E-05	1.05E-06	6.59E-05	6.59E-06	5.11E-05	5.11E-06	-	-
Carbon disulfide	0.14	0.00	311	7.30E-01	3.12E-06	3.12E-07	1.96E-05	1.96E-06	1.52E-05	1.52E-06	-	-
Carbonyl sulfide	0.09	0.00	30	X	2.08E-06	X	1.31E-05	X	1.01E-05	X	-	X
Chlorobenzene	0.09	0.00	1,000	1.04E+00	1.99E-06	1.99E-07	1.25E-05	1.25E-06	9.69E-06	9.69E-07	-	-
Chloroethane (ethyl chloride)	0.26	0.00	1,250	1.04E+01	5.93E-06	5.93E-07	3.73E-05	3.73E-06	2.89E-05	2.89E-06	-	-
Dichlorobenzene	0.10	0.00	300	3.06E-04	2.18E-06	2.18E-07	1.37E-05	1.37E-06	1.06E-05	1.06E-06	-	-
Dichloromethane (methylene chloride)	3.68	0.06	347	4.03E-03	8.41E-05	8.41E-06	5.28E-04	5.28E-05	4.10E-04	4.10E-05	-	-
Ethylbenzene	1.51	0.02	250	1.04E+00	3.45E-05	3.45E-06	2.17E-04	2.17E-05	1.68E-04	1.68E-05	-	-
Hexane	1.76	0.03	11,649	2.21E+00	4.02E-05	4.02E-06	2.53E-04	2.53E-05	1.96E-04	1.96E-05	-	-
Methyl isobutyl ketone	0.59	0.01	500	3.13E+00	1.34E-05	1.34E-06	8.45E-05	8.45E-06	6.55E-05	6.55E-06	-	-
Perchloroethylene (tetrachloroethylene)	1.90	0.03	814	3.20E-04	4.34E-05	4.34E-06	2.73E-04	2.73E-05	2.11E-04	2.11E-05	-	-
Toluene - No or Unknown Co-disposal	11.12	0.17	1,923	5.21E+00	2.54E-04	2.54E-05	1.60E-03	1.60E-04	1.24E-03	1.24E-04	-	-
Trichloroethylene (trichloroethene)	1.14	0.02	1,450	1.68E-05	2.60E-05	2.60E-06	1.63E-04	1.63E-05	1.27E-04	1.27E-05	-	CAAC
Vinyl chloride	1.41	0.02	2,099	2.15E-04	3.22E-05	3.22E-06	2.03E-04	2.03E-05	1.57E-04	1.57E-05	-	-
Xylenes	3.94	0.06	1,736	1.04E-01	9.00E-05	9.00E-06	5.66E-04	5.66E-05	4.39E-04	4.39E-05	-	-

SCENARIO 2: WORST CASE SINGLE FLARE

FL-1:	FL-2:	FL-3:	
2.28	2.28	2.28	lb/hr - HCl
30.8	32.8	32.5	ft - stack height
72	114	106	in - diameter
1,045.1	1,475.4	1,338.7	°F - rated temperature
32,129	28,789	21,218	scfm - exhaust
41.5	161.0	148.2	µg/m³ - HCl conc.

HAP	LandGEM (tpy)	Post-flare*	AAAC (mg/m³)	CAAC (mg/m³)	1-hr conc. (mg/m³)	Scaled annual mg/m³)	EXCEED?	
Hydrochloric Acid	-	9.98	16	2.09E-02	***1.48E-01***	1.48E-02	-	-
1,1,1-Trichloroethane (methyl chloroform)	0.20	0.00	2,075	2.30E+00	4.41E-05	4.41E-06	-	-
1,1,2,2-Tetrachloroethane	0.57	0.01	18	3.27E-05	1.27E-04	1.27E-05	-	-
1,1-Dichloroethane (ethylidene dichloride)	0.74	0.01	405	7.29E-05	1.64E-04	1.64E-05	-	-
1,1-Dichloroethene (vinylidene chloride)	0.06	0.00	38	2.09E-01	1.34E-05	1.34E-06	-	-
1,2-Dichloroethane (ethylene dichloride)	0.13	0.00	405	7.29E-05	2.80E-05	2.80E-06	-	-
1,2-Dichloropropane (propylene dichloride)	0.06	0.00	250	4.17E-03	1.40E-05	1.40E-06	-	-
Acrylonitrile	1.04	0.02	38	2.79E-05	2.30E-04	2.30E-05	-	-
Benzene - No or Unknown Co-disposal	0.46	0.01	1,276	2.43E-04	1.02E-04	1.02E-05	-	-
Carbon disulfide	0.14	0.00	311	7.30E-01	3.04E-05	3.04E-06	-	-
Carbonyl sulfide	0.09	0.00	30	X	2.03E-05	2.03E-06	-	X
Chlorobenzene	0.09	0.00	1,000	1.04E+00	1.94E-05	1.94E-06	-	-
Chloroethane (ethyl chloride)	0.26	0.00	1,250	1.04E+01	5.78E-05	5.78E-06	-	-
Dichlorobenzene	0.10	0.00	300	3.06E-04	2.13E-05	2.13E-06	-	-
Dichloromethane (methylene chloride)	3.68	0.06	347	4.03E-03	8.20E-04	8.20E-05	-	-
Ethylbenzene	1.51	0.02	250	1.04E+00	3.36E-04	3.36E-05	-	-
Hexane	1.76	0.03	11,649	2.21E+00	3.92E-04	3.92E-05	-	-
Methyl isobutyl ketone	0.59	0.01	500	3.13E+00	1.31E-04	1.31E-05	-	-
Perchloroethylene (tetrachloroethylene)	1.90	0.03	814	3.20E-04	4.23E-04	4.23E-05	-	-
Toluene - No or Unknown Co-disposal	11.12	0.17	1,923	5.21E+00	2.48E-03	2.48E-04	-	-
Trichloroethylene (trichloroethene)	1.14	0.02	1,450	1.68E-05	2.54E-04	2.54E-05	-	CAAC
Vinyl chloride	1.41	0.02	2,099	2.15E-04	3.14E-04	3.14E-05	-	-
Xylenes	3.94	0.06	1,736	1.04E-01	8.78E-04	8.78E-05	-	-

SITE-WIDE PTE PROJECTION FOR 2021

Enter year of emissions inventory:	2021
Minimum destruction efficiency for organics:	98%
Approximate total capture efficiency of GCCS:	75%
VOC fraction of NMOC (39% no co-disposal, 85% co-disposal):	39%

Gas / Pollutant	***Pre flare (tpy)***	***Post flare (tpy)***	***Fugitive (tpy)***
Total landfill gas (LFG)	92,930	1,394	23,233
Methane (CH4)	24,820	372	6,205
Carbon dioxide (CO2)	68,110	-	-
Non-methanic organic compounds (NMOC)	616	9.25	154.10
Volatile organic compounds (VOC)	240	3.61	72.10
Carbon monoxide (CO)	12.14	20.78	3.04
Oxides of nitrogen (NOx)	-	17.47	-
Sulfur dioxide (SO2)	-	7.32	-
Particulate (PM10/PM2.5)	-	6.72	134.16
Hydrogen sulfide (H2S)	3.80	0.06	0.95
Total hazardous air pollutants (HAPs)	-	10.45	19.94
Single HAP (HCl)	-	9.98	-
1,1,1-Trichloroethane		0.00	0.05
1,1,2,2-Tetrachloroethane		0.01	0.14
1,1-Dichloroethane		0.01	0.18
1,1-Dichloroethene		0.00	0.02
1,2-Dichloroethane		0.00	0.03
1,2-Dichloropropane		0.00	0.02
Acrylonitrile		0.02	0.26
Benzene		0.01	0.12
Carbon disulfide		0.00	0.03
Carbon tetrachloride		0.00	0.00
Carbonyl sulfide		0.00	0.02
Chlorobenzene		0.00	0.02
Chloroethane		0.00	0.06
Chloroform		0.00	0.00
Dichlorobenzene		0.00	0.02
Dichloromethane		0.06	0.92
Ethylbenzene		0.02	0.38
Ethylene dibromide		0.00	0.00
Hexane		0.03	0.44
Methyl isobutyl ketone		0.01	0.15
Perchloroethylene		0.03	0.47
Toluene		0.17	2.78
Trichloroethylene		0.02	0.28
Vinyl chloride		0.02	0.35
Xylenes		0.06	0.99
Mercury		1.35E-04	4.50E-05

- As per AP-42, control efficiencies may also be applied to all LFG constituents except mercury. Mercury emissions are unaffected by combustive controls.

- 75% capture || 98% combustion || 25% fugitive

ATTACHMENTS:

V03002_2000_AERSCREEN_FL-1.asz

V03002_2000_AERSCREEN_FL-2.asz

V03002_2000_AERSCREEN_FL-3.asz

V03002_2000_AERSCREEN_WORST CAS

V03002_2000_LandGem.xls

V03002_2000_calcs.xlsx